

## **SECTION 15**

### **RIGGING**

#### **15.A GENERAL**

##### **15.A.01 Inspection and use.**

- a. Rigging equipment for material handling shall be inspected as specified by the manufacturer, by a qualified person, before use on each shift and as necessary during its use to ensure that it is safe.
- b. Defective rigging, as specified in Appendix F, shall be removed from service.
- c. The use and maintenance of rigging equipment shall be in accordance with recommendations of the rigging manufacturer and the equipment manufacturer: rigging equipment shall not be loaded in excess of its recommended safe working load.
- d. Rigging equipment, when not in use, shall be removed from the immediate work area and properly stored and maintained in a safe condition.

##### **15.A.02 Hoist rope shall not be wrapped around the load.**

##### **15.A.03 Running lines located within 2 m (6 ft - 6 in) of the ground or working level shall be guarded or the area restricted.**

##### **15.A.04 All eye splices shall be made in an approved manner; rope thimbles of proper size shall be fitted in the eye, except that in slings the use of thimbles shall be optional.**

##### **15.A.05 When hoisting loads, a positive latching device shall be used to secure the load and rigging.**

15.A.06 Hooks, shackles, rings, pad eyes, and other fittings that show excessive wear or that have been bent, twisted, or otherwise damaged shall be removed from service.

15.A.07 Custom designed grabs, hooks, clamps, or other lifting accessories for such units as modular panels, prefabricated structures, and similar materials shall be marked to indicate the safe working loads and shall be proof-tested, before use, to 125% of their rated load.

15.A.08 The practice of "Christmas tree lifting" steel is prohibited.

## 15.B WIRE ROPE

15.B.01 When two wires are broken or rust or corrosion is found adjacent to a socket or end fitting, the wire rope shall be removed from service or resocketed. **> Special attention shall be given to the inspection of end fittings on boom support, pendants, and guy ropes**

15.B.02 Wire rope removed from service due to defects shall be cut up or plainly marked as unfit for further use as rigging.

15.B.03 Wire rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope: the clip nuts shall be retightened immediately after initial load carrying use and at frequent intervals thereafter. **> See Figure 15-1**

15.B.04 When a wedge socket fastening is used, the dead or short end of the wire rope shall have a clip attached to it or looped back and secured to itself by a clip: the clip shall not be attached directly to the live end.

15.B.05 Protruding ends of strands in splices on slings and bridles shall be covered or blunted.

15.B.06 Except for eye splices in the ends of wires and for endless wire rope slings, wire rope used in hoisting, lowering, or

pulling loads, shall consist of one continuous piece without knot or splice.

a. An eye splice made in any wire rope shall have not less than five full tucks (this requirement shall not preclude the use of another form of splice or connection which can be shown to be as efficient and which is not otherwise prohibited).

b. Wire rope shall not be secured by knots except on haul back lines on scrapers.

15.B.07 Eyes in wire rope bridles, slings, or bull wires shall not be formed by wire rope clips or knots.

15.B.08 Wire rope clips shall not be used to splice rope.

## 15.C CHAIN

15.C.01 Only alloyed chain shall be used in rigging.

15.C.02 Chain shall be inspected before initial use and weekly thereafter.

15.C.03 When used with alloy steel chains, hooks, rings, oblong links, pear-shaped links, welded or mechanical coupling links, or other attachments shall have a rated capacity at least equal to that of the chain.

15.C.04 Job or shop hooks and links, makeshift fasteners formed from bolts and rods, and other similar attachments shall not be used.

## 15.D FIBER ROPE (NATURAL AND SYNTHETIC)

15.D.01 Fiber rope shall not be used if it is frozen or if it has been subjected to acids or excessive heat.

15.D.02 Fiber rope shall be protected from abrasion by padding

where it is fastened or drawn over square corners or sharp or rough surfaces.

15.D.03 All splices in rope slings provided by the employer shall be made in accordance with fiber rope manufacturer's recommendations.

15.D.04 Eye splices.

- a. In manila rope, eye splices shall contain at least three full tucks and short splices shall contain at least six full tucks (three on each side of the centerline of the splice).
- b. In layed synthetic fiber rope, eye splices shall contain at least four full tucks and short splices shall contain at least eight full tucks (four on each side of the centerline of the splice).

15.D.05 Strand end tails shall not be trimmed short (flush with the surface of the rope) immediately adjacent to the full tucks: this applies to both eye and short splices and all types of fiber rope.

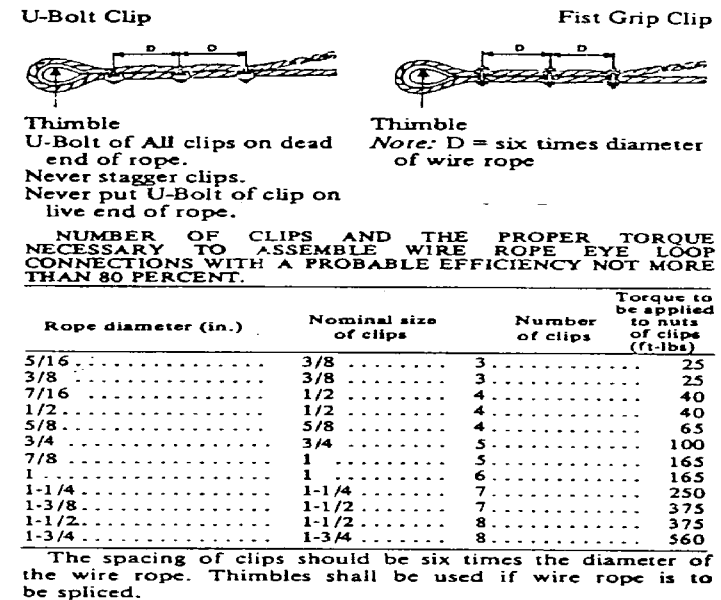
- a. For fiber ropes less than 2.5 cm (1 in) diameter, the tails shall project at least six rope diameters beyond the last full tuck.
- b. For fiber ropes 2.5 cm (1 in) diameter and larger, the tails shall project at least 15 cm (6 in) beyond the last full tuck.

In applications where the projecting tails may be objectionable, the tails shall be tapered and splices into the body of the rope using at least two additional tucks (which will require a tail length of approximately six rope diameters beyond the last full tuck).

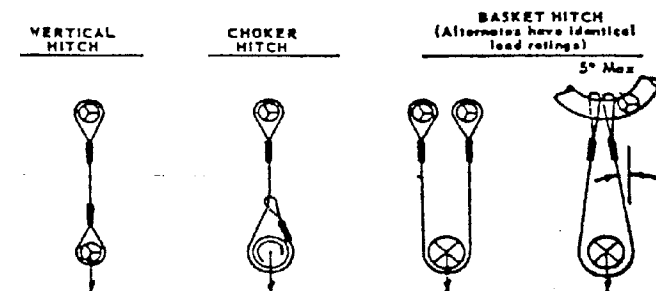
15.D.06 For all eye splices, the eye shall be sufficiently large to provide an included angle of not greater than 60° at the splice when the eye is placed over the load or support.

15.D.07 Knots shall not be used in lieu of splices.

**FIGURE 15-1  
WIRE ROPE CLIPS**



**FIGURE 15-2  
SLING CONFIGURATIONS**



## 15.E SLINGS

15.E.01 Slings and their fittings and fastenings, shall be inspected before use on each shift and as necessary during use.

15.E.02 Protection shall be provided between the sling and sharp unyielding surfaces of the load to be lifted.

15.E.03 The use of slings will be such that the entire load is positively secured.

15.E.04 Lengths.

- a. Wire rope slings shall have a minimum length of clear wire rope equal to ten times the rope diameter between each end fitting or eye splice.
- b. Braided slings shall have a minimum clear length of braided body equal to forty times the diameter of component ropes between each end fitting or eye splice.

15.E.05 Welded alloy steel chain slings shall have affixed durable permanent identification stating size, grade, rated capacity, and sling manufacturer.

15.E.06 The employer shall have each synthetic web sling marked or coded to show:

- a. name or trademark of the manufacturer,
- b. rated capacities for the type of hitch, and
- c. type of material.

## 15.F RIGGING HARDWARE

15.F.01 Drums, sheaves, and pulleys shall be smooth and free of surface defects which may damage rigging.

15.F.02 The ratio between the diameter of the rigging and the

drum, block, sheave, or pulley tread diameter shall be such that the rigging will adjust itself to the bend without excessive wear, deformation, or damage.

15.F.03 In no case will the safe diameters of drums, blocks, sheaves, or pulleys be reduced in replacement of such items unless compensating changes are made in terms of the rigging used and the safe loading limits.

15.F.04 Drums, sheaves, or pulleys having eccentric bores, cracked hubs, spokes, or flanges shall be removed from service.

15.F.05 Connections, fittings, fastenings, and attachments used with rigging shall be of good quality, of proper size and strength, and shall be installed in accordance with recommendations of the manufacturer.

15.F.06 Shackles.

- a. Table 15-1 shall be used to determine the safe working loads of various sizes of shackles, except that higher safe working loads are permissible when allowed by the manufacturer if a safety factor of at least five is maintained.
- b. Shackles shall not be eccentrically loaded.

15.F.07 Hooks.

- a. The manufacturer's recommendations shall be followed in determining the safe working loads of the various sizes and types of specific and identifiable hooks. Any hook for which the manufacturer's recommendations are not available shall be tested to twice the intended safe working load before it is put into use: the employer shall maintain a record of the dates and results of such tests.
- b. Open hooks are prohibited in rigging used to hoist loads.

- c. Hoisting hooks rated at 9,000 kg (10 tons) or larger shall be provided with a means for safe handling.

#### 15.F.08 Drums.

- a. Drums shall have sufficient rope capacity with recommended rope size and reeving to perform all hoisting and lowering functions.

**TABLE 15-1**

**SAFE WORKING LOADS FOR SHACKLES**

Material size	Pin diameter	Safe working load
1.3 cm	1.6 cm	1,270 kg
1.6 cm	1.9 cm	2,000 kg
1.9 cm	2.2 cm	2,900 kg
2.2 cm	2.5 cm	3,900 kg
2.5 cm	2.8 cm	5,080 kg
2.8 cm	3.1 cm	6,080 kg
3.1 cm	3.4 cm	7,450 kg
3.4 cm	3.8 cm	9,080 kg
3.8 cm	4.1 cm	10,800 kg
4.4 cm	5 cm	14,700 kg
5 cm	5.6 cm	19,300 kg

- b. At least three full wraps (not layers) of rope shall remain on the drum at all times.

- c. The drum end of the rope shall be anchored by a clamp securely attached to the drum with an arrangement approved by the manufacturer.

- d. Grooved drums shall have the correct groove pitch for the diameter of the rope: the depth of the groove shall be correct for the diameter of the rope.

(1) The flanges on grooved drums shall project beyond the last layer of rope a distance of either 5 cm (2 in) or twice the diameter of the rope, whichever is greater.

(2) The flanges on ungrooved drums shall project beyond the last layer of rope a distance of either 6.3 cm (2.5 in) or twice the diameter of the rope, whichever is greater.

#### 15.F.09 Sheaves.

- a. Sheaves shall be compatible with the size of rope used, as specified by the manufacturer.
- b. Sheaves shall be inspected to insure they are of correct size, properly aligned, lubricated, and in good condition.
- c. When rope is subject to riding or jumping off a sheave, the sheave shall be equipped with cable-keepers.

#### 15.F.10 Eye bolts.

- a. Shoulderless eye bolts shall not be loaded at an angle.
- b. Eye bolts shall only be loaded in the plain of the eye and shall not be loaded at angles of less than 45° to the horizontal.

## DEFINITIONS

Braided sling: a sling made from braided rope.

Bridle sling: multiple-leg-sling; the legs of the sling are spread to distribute the load.

Cable laid rope: a rope composed of several wire ropes laid as strands around a wire rope core.

Cable laid rope sling, mechanical joint: a wire rope sling made from a cable laid wire rope with eyes fabricated by pressing or swaging metal sleeves over the rope junction.

Cable laid endless sling - mechanical joint: a wire rope sling made from one continuous length of cable laid rope with the ends joined by one or more metallic fittings.

Cable laid grommet, hand tucked: an endless wire rope sling made from one continuous length of rope formed to make a body composed of six ropes around a rope core. The rope ends are tucked into the body, forming the core. No sleeves are used.

Choker: a sling used to form a slip noose around an object.

Christmas tree lifting: the tandem lifting of steel (multiple steel members rigged together) by one crane.

Coarse laid rope: 6 x 7 wire rope (6 strands, 7 wires per strand).

Endless rope: rope in which the ends are spliced together.

Fleet angle: the angle between the rope as it leaves the drum (at the extreme end wrap on a drum) for the sheave and an imaginary center-line passing through the center of the sheave groove and a point halfway between the ends of the drum.

Grommet: an endless 7-strand wire rope.

Independent wire rope core: a small 6 x 7 wire rope with a wire strand core; used to provide greater resistance to crushing and distortion of the wire rope.

Reeving: a rope system in which the rope travels around drums and sheaves.

Rotation resistant rope: a wire rope consisting of an inner layer of strand laid in one direction covered by a layer of strand laid in the opposite direction: this has the effect of counteracting torque by reducing the tendency of the finished rope to rotate.

Shackle: a U-shaped metal fitting with a pin through the ends.

Sheave: the grooved wheel of a pulley or block over which rope or cable is passed.

Sling: an assembly used for lifting when connected to a lifting mechanism at the sling's upper end and when supporting a load at the sling's lower end. > **See Figure 15-2**

Sling - vertical: a load suspended on a single, vertical, part or leg.

Sling - basket: loading with the sling passed under the load with both ends, end attachments, eyes, or handles on the hook or a single master link.

Sling - choker: loading with the sling passed through one end attachment, eye, or handle and suspended by the other.

Splice - eye: a splice formed by bending a rope's end back onto itself and splicing it into the rope so that a loop is formed.

Splice - hand tucked: a loop formed in the end of a rope by tucking the end of the strands back into the main body of the rope.

Splice - long: a splice without an appreciable increase of circumference that is used when the rope must run over a sheave

or through a hole.

Splice - mechanical: a loop formed in the end of a rope and connected by pressing (swaging) one or more metal sleeves over the junction of the rope.

Splice - short: a splice using less material than a long splice but increasing the circumference.

Strand laid rope: a wire rope made with strands formed around a fiber core, wire core, or independent wire rope core.

Swaged fittings: fittings in which wire rope is inserted and attached by cold flowing method.

Wire rope: a number of strands laid helically about a metallic or non-metallic core. Each strand consists of a number of wires also laid helically about a metallic or non-metallic center. Wire rope is specified by the kind of core, the number of strands, the number, sizes, and arrangement of the wires in each strand, and the way in which the wires and strands are wound or laid about each other. Wire rope is commonly designated by two numbers: the first indicating the number of strands and the second the number of wires per strand (for ropes with a wire strand core, a second group of two numbers may be used to indicate the construction of the wire core).

Wire strand core: consists of a multiple-wire strand that may be the same as one of the strands of the rope: it is smoother and more solid than the independent wire rope core and provides a better support for the rope strands.

## SECTION 16

### MACHINERY AND MECHANIZED EQUIPMENT

#### 16.A GENERAL

16.A.01 Before any machinery or mechanized equipment is placed in use, it shall be inspected and tested by a competent person and certified to be in safe operating condition.

- a. Inspections and tests shall be in accordance with the manufacturer's recommendations and shall be documented.
- b. Records of tests and inspections shall be maintained at the site by the contractor, and shall be made available upon request of the designated authority, and shall become part of the official project file.

16.A.02 Daily/shift inspections and tests.

- a. All machinery and equipment shall be inspected daily (when in use) to ensure safe operating conditions: the employer shall designate competent persons to conduct the daily inspections and tests.
- b. Tests shall be made at the beginning of each shift during which the equipment is to be used to determine that the brakes and operating systems are in proper working condition and that all required safety devices are in place and functional.

16.A.03 Whenever any machinery or equipment is found to be unsafe, or whenever a deficiency which affects the safe operation of equipment is observed, the equipment shall be immediately taken out of service and its use prohibited until unsafe conditions have been corrected.

- a. A tag indicating that the equipment shall not be operated, and that the tag shall not be removed, shall be placed in a